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POLLEN MORPHOLOGY OF SOME NATIVE AND CULTIVATED SPECIES OF THE GENUS *PHOENIX* L. FROM PAKISTAN AND KASHMIR

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ABSTRACT

Pollen morphology of 4 species (*Phoenix dactylifera, P. loureinii, P. sylvestris, P. roebelenii*) belonging to the genus *Phoenix* L.of the family Palmae has been studied from Pakistan and Kashmir by using Light Microscope (LM) and Scanning Electron Microscope (SEM). Palynologically, the genus *Phoenix* L. is a stenopalynous taxon. Pollen are usually asymmetrical, iso-heteropolar, monosulcate, mostlyellipitic -oval or oblong- subroundedin polar view and boat-like (longitudinally) or kidney shaped (transversely) in equatorial view. Two pollen types are recognized on the basis of the shape of pollen viz., *Phoenix dactylifera*-type and *Phoenix roebelenii*-type. Key to the studied species is also given. Pollen morphology is significantly helpful at specific level within the pollen type.

Key-words: Pollen morphology, *Phoenix*s species, Pakistan, Kashmir.

INTRODUCTION

The genus *Phoenix* L. belongs to the family Palmae subfamily Coryphoideae and the monotypic genus of the tribe Phoeniceae. The genus comprise of c.14 species (Govaerts and Dransfield, 2005; Henderson *et al*., 2006; WCSP, 2013) and distributed from Canary Island east across the Northern and Southern Africa in to the Middle East. From South Europe and South East Asia from Turkey east to Southern China and Malaysia (Fig 1).In Pakistan the genus *Phoenix* L. is represented by 5 species among these species *Phoenix sylvestris* (L.) Roxb. is the wild. The genus is unique among Coryphoideae, being the only genus with pinnate leaves. Furthermore, among all the palm genera, the genus *Phoenix* L. is the most distinctive by having the following characters such as dioecious flower, induplicate leaves (V-shaped in cross section) and presence of acanthophylls. At the molecular level, the genus also appears highly divergent from other palms but it remains hardly classifiable in Cladistic analysis (Asmussen and Chase 2001; Hahn 2002; Baker *et al*., 2009).Human use of palms is as old as human civilization itself, starting with the cultivation of the date palm. The importance of palms is mentioned more than 30 times in the Bible and at least 22 times in the Quran.

The *Phoenix dactylifera* (date palm) is cultivated mainly for its fruit and also provides a favorable environment for the cultivation of other species such as olives, figs, vegetables and in Asianagro systems (Tengberg and Newton, 2007). The sap of *P. sylvestris* (L.) Roxb.is boiled to produce a sweet juice (Newton *et al*., 2013). *P. canarrensis* Hort. ex Chabaud is used for ornamentation. The pollen morphology of cultivated plants has attained great deal of attention in recent years due to its effective application in interpretation of the taxonomy and to find out the inter-relationships of cultivated taxa. There are several palynological studies on species belonging to the genus *Phoenix* L. such as Erdtman (1952), Mahabale (1967) and Sowunmi (1968, 1972), Kedves (1980).This is the first attempt to analyze the detailed palynological studies of the genus *Phoenix* L. from Pakistan and Kashmir.

MATERIALS AND METHODS

Fresh and healthy pollen materials of 4 species of the genus *Phoenix* L. were collected from the natural population. In few cases herbarium specimens were used present in the Herbarium, Centre for Plant Conservation, University of Karachi. 10-20 measurements of each sample were taken. For Light microscopy (LM) slides were made following the standard procedure of Erdtman (1960) and observation were made with (Nikon Type 102), and for Scanning electron microscope (Joel JSM- 6380 A), pollen were directly mounted on a metallic stub with the help of double adhesive tape and coated with gold. Using light microscope following parameters were measured such as Polar length (P), Equatorial diameter (E), P/E ratio, Colpus length and Exine thickness. The terminology used in accordance with Erdtman (1952, 1960), Faegri and Iversen (1964), Kremp (1965) and Moore and Webb (1978).

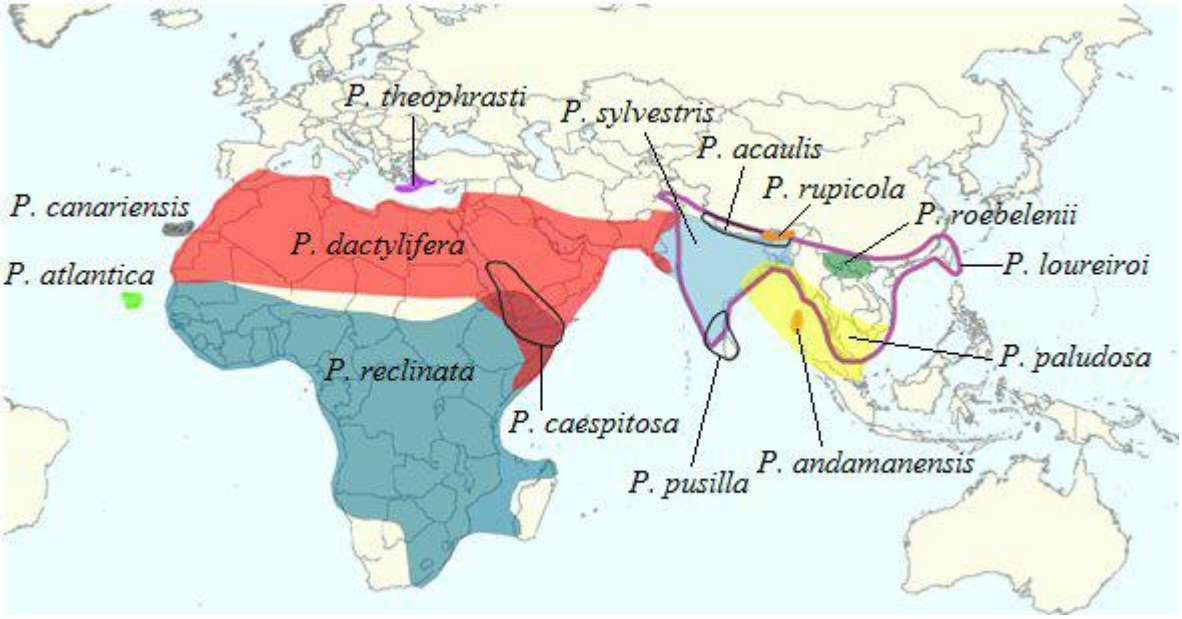

Fig. 1. World distribution of the *Phoenix* species
(Map by Henderson, 2009)

OBSERVATIONS

Pollen characters of the genus*Phoenix* L.

The genus Phoenix is represented by 5 species from the area under consideration. However the pollen of *Phoenixcanariensis* could not be studied due to non availability of material. Pollenare usually monocolpate, asymmetric sometime symmetric, isopolar toheteropolar. Outline in polar view is oval-elliptic andoblong or sub rounded, whereas in equatorial viewtransversely kidney shaped and boat-shapedlongitudinaly (Fig-2 A, C, E & G). The Polar length (P) rangefrom 15.70-28.70 µm whereas the range of Equatorial diameter (E) is 21.05-27.65 µm.P/E 0.80-1.00.Colpus distinct, slit-like, acute at the both ends.The aperture more or lesssame length as long axis and located at the distal pole ofpollen .Themuri being simplibaculate. The exine is reticulate and thickness ranges from 1.0-1.10 µm.Tectum surface is perforate, ranging from fine to coarse with sparse to dense distribution (Fig 2B, D, F & H).

All the studied species belonging to the genus *Phoenix* L. grouped under 2 pollen types viz., *Phoenix dactylifera* -type and *Phoenix roebelenii*–type.Detail of pollen characters are given in Table1.

Table 1. General characters of pollen type:*Phoenix dactylifera*-type.

Name of taxa	Polar length in µm	Equatorial diameter in µm	P/E ratio	Colpus lengthin µm	Exine thickness in µm	Tectum
P. dactylifera L.	18.60 (21.85) 25.10	22.10 (24.65) 27.20	0.89	21.30 (24.15) 27.00	1.0	reticulate
P. loureirii Kunth	15.70 (18.75) 21.05	21.05 (23.67) 26.30	0.80	20.40 (22.95) 25.50	1.10	reticulate
P. sylvestris (L.) Roxb.	20.10 (23.95) 27.80	23.30 (25.25) 27.20	0.95	22.30 (24.25) 26.20	1.0	reticulate

Description of pollen types

Pollen type-I: *Phoenix dactylifera*-type (Fig. 2A-F)

Diagnosis: Pollen hetero- polar, asymmetric, outline:elliptic to oval in polar view whereas kidney shaped (transversely) and boat shaped (longitudinally) in equatorial view.

Pollen class: Monocolpate

Shape: Suboblate oroblate-spheroidal
Apertures:1-sulcate and located at the distal pole

Exine: Sexine thicker as nexine
Ornamentation: Tectum reticulate
Measurements (Size): Length18.60 (23.20) 27.80 µm, Breadth 21.05(24.12) 27.20 µm in diameter and Colpus length 20.40 (23.70) 27.00 µm. P/E ratio is 0.80- 0.95.Exine 1.0-1.1 µm thick.

Species included:3 species are included in this pollen type. i.e., *Phoenix dactylifera* L., *Phoenix loureirii* Kunthand *Phoenix sylvestris* (L.)Roxb. , which represents 75% of the taxa.

Key to the Species

1+ Pollen suboblate, c. 21.05µm in length. P/E ratio is 0.80……..……***P. loureirii***
- Pollen oblate-spheroidal, c. 27.80µm in length. P/E ratio is 0.89-0.95..……***P. dactylifera & P. sylvestris***

Pollen type-II: *Phoenix roebelenii*-type (Fig. 2G & H)

Diagnosis: Pollen iso-polar, somewhat symmetric, outline: oblong-subrounded

Pollen class: Monocolpate
Shape: Prolate-spheroidal
Apertures: More or less same length as long axis
Exine: Sexine thicker as nexine
Ornamentation: Tectum reticulate, surface patterning coarsely perforate with dense distribution.
Measurements (Size): Length20.30 (24.50) 28.70 µm, Breadth 21.20 (24.42) 27.65 µm in diameter and Colpus length 20.00 (23.55) 27.10 µm. P/E ratio is 1.00 . Exine 1.00 µm thick.

Species included: *Phoenix roebelenii* O'Brien which represents only 25% of the total taxa.

RESULTS AND DISCUSSION

The majority of Palm species produce simple tectate, columellate and monosulcate pollen (Harley, 1990). The monocolpate is the predominant aperture type in the family Palmae which is considered by some workers to be primitive character (Wodehouse, 1935, 1936 and Meeuse, 1965). The pollen morphological study of four selected species of the genus *Phoenix* L. belonging to the family Palmae (subfamily Coryphoideae) have remarkably similar and uniform pollen features i.e., monosulcate pollen and sculpturing pattern is predominantly reticulate with fine – coarse (mottled) perforation. The above findings are in accordance with various previous workers such as Erdtman (1960), Mahabalé (1967), Sowunmi (1968, 1972), Kedves (1980) and Harley (1990) in the genus *Phoenix* L.The species are separated mainly into two groups on the basis of pollen structure, polarity and symmetry viz., *Phoenix dactylifera*-type and *Phoenix roebelenii*-type (Table 1; Fig. 2).

The micro morphological data shows that pollen of *Phoenix* L. are usually asymmetric, oval – elliptic in polar view, while kidney-shaped in transverse equatorial view and boat shaped in longitudinal equatorial view except the *P. roebelenii* O'Brien which have nearly symmetrical, oblong-sub-rounded pollen (Table-1; Fig.1). Such observations have also been made by Sowunmi (1968), Kedves (1980) and Harley (1990). However, the size of pollen is of limited importance because the length of one species overlaps with others and usually varies from 15.70-28.70 µm. The exception here is the pollen of *Phoenix loureirii* Kunth(Table 1) which is about 15.70 - 21.05 µm long easily distinguished from all other species. On the other hand, colpus length, pollen aperture, exine thickness and tectum surface are not an important taxonomic characters to distinguish species of the genus *Phoenix* L. more clearly.

The present findings make it clear that the palynological data from the area under study support at the specific level within the pollen type, the delimitation of taxa of the genus *Phoenix* L. The foregoing discussion concludes that the pollen characters have significant role for isolation of taxa along with other floral and vegetative characters.

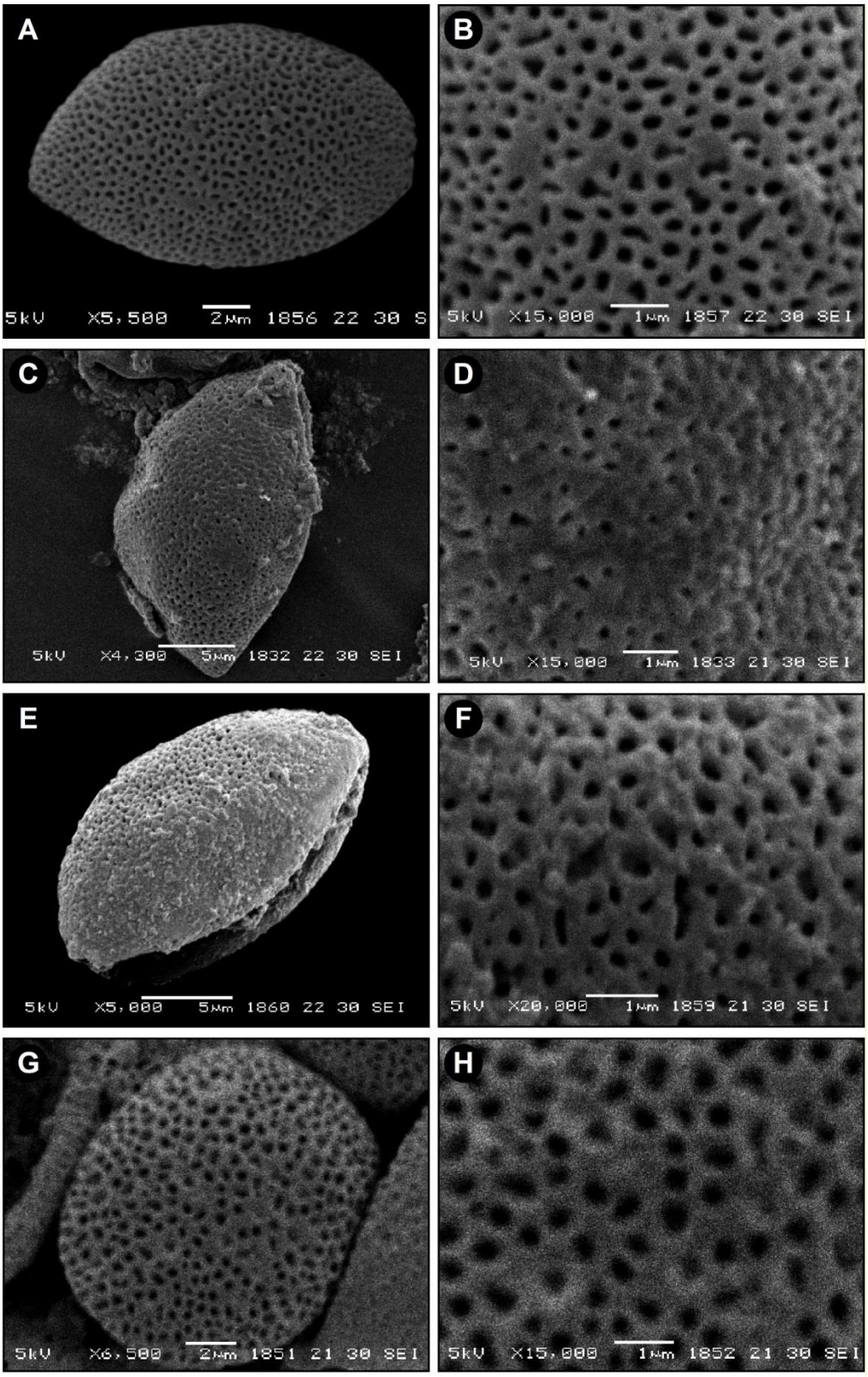

Fig. 2. Scanning electron micrographs. ***Phoenix dactylifera*:** A, equatorial view; B, exine pattern. ***P. loureinii*:** C, polar view; D, exine pattern. ***P. sylvestris*:** E; equatorial view; F, exine pattern. ***P. roebelenii*:** G, equatorial view; H, exine pattern.

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